

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 03-1-0501 -X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION: 1 08/09/00

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:GH2/GO2 1" REPRESS DISCONNECT (ORB) UNITED SPACE ALLIANCE - NSLD	MC276-0003-0007
LRU	:GH2/GO2 1" REPRESS DISCONNECT (GND) UNITED SPACE ALLIANCE - NSLD	MC276-0003-0008

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

DISCONNECT, PREPRESSURIZATION ONE INCH, SELF SEALING, GH2/GO2 SYSTEM.

DISCONNECT WAS ORIGINALLY DESIGNED AND MANUFACTURED BY FAIRCHILD BUT IS NOW MANUFACTURED BY UNITED SPACE ALLIANCE-NSLD AS AN ALTERNATE PRODUCTION AGENCY.

REFERENCE DESIGNATORS: PD10
PD9

QUANTITY OF LIKE ITEMS: 2
ONE GH2, ONE GO2

FUNCTION:

CONNECTS WITH GSE TO PROVIDE HELIUM FOR PROPELLANT TANK PRESSURIZATION AND ANTI-ICING PURGE. ACTS AS REDUNDANT CLOSURE DEVICE WITH PREPRESSURIZATION CHECK VALVE (CV17/CV16) AFTER FLOW CESSATION TO PREVENT OVERBOARD LOSS OF ET PRESSURANT THROUGH ORBITER PLUMBING. THE PRESSURE ACTUATED POPPET IN THE DISCONNECT REQUIRES A DELTA P TO OPEN.

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SUBSYSTEM NAME: MAIN PROPULSION

LRU: GH2/GO2 1" REPRESS DISC ORB (PD9, 10)

ITEM NAME: GH2/GO2 1" REPRESS DISC ORB (PD9, 10)

CRITICALITY OF THIS

FAILURE MODE: 1R2

FAILURE MODE:

EXTERNAL LEAKAGE PAST MATING SEAL OR SWIVEL SEAL DURING LOADING.

MISSION PHASE: PL PRE-LAUNCH

VEHICLE/PAYLOAD/KIT EFFECTIVITY:	102	COLUMBIA
	103	DISCOVERY
	104	ATLANTIS
	105	ENDEAVOUR

CAUSE:

DAMAGED MATING SEAL, CONTAMINATION, DAMAGED SWIVEL SEAL, PIECE PART STRUCTURAL FAILURE OF MATING SURFACE

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

- A) PASS
- B) N/A
- C) PASS

PASS/FAIL RATIONALE:

A)

B)

DISCONNECT IS STANDBY REDUNDANT TO PREPRESS CHECK VALVE. FAILURE IS NOT DETECTABLE BECAUSE NO INSTRUMENTATION EXISTS TO DETECT INTERFACE SEAL LEAKAGE (HGDS IS NOT SET TO DETECT GHE AT THE T-0).

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF ONE LEVEL OF REDUNDANCY TO PREVENT GH2/GO2 LEAKAGE OVERBOARD. GHE FROM THE ET ANTI-ICING PURGE WILL LEAK OVERBOARD RESULTING IN ICE BUILD-UP ON THE ET PREPRESS LINE. POSSIBLE DAMAGE DUE TO ICE IMPACT ON ORBITER AND/OR ET TPS.

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(B) INTERFACING SUBSYSTEM(S):

SAME AS A.

(C) MISSION:

POSSIBLE LAUNCH SCRUB DUE TO ICE BUILDUP ON ET PREPRESS LINE. OTHERWISE NO EFFECT.

(D) CREW, VEHICLE, AND ELEMENT(S):

SAME AS C.

(E) FUNCTIONAL CRITICALITY EFFECTS:

1R/2 2 SUCCESS PATHS. TIME FRAME - PRELAUNCH.

- 1) DISCONNECT (PD10 OR PD9) INTERFACE SEAL LEAKAGE.
- 2) RESPECTIVE CHECK VALVE (CV17 OR CV16) FAILS TO CHECK.

RESULTS IN OVERBOARD LEAKAGE OF GHE, GH2, AND/OR GO2. POSSIBLE FIRE HAZARD AT THE VEHICLE EXTERIOR. GHE PURGE OF THE T-0 UMBILICAL MAY LOWER THE GH2 CONCENTRATION BELOW FLAMMABILITY LIMITS. H2 FIRE DETECTABLE USING UV SENSORS AT THE MLP TSM HOOD. POSSIBLE LOSS OF CREW/VEHICLE.

-DISPOSITION RATIONALE-

(A) DESIGN:

A CHECK VALVE IS PROVIDED DOWNSTREAM TO PREVENT GH2/GO2 FLOW INTO THE Q.D. SPECIFICATION ALLOWS 200 SCIMS OF EXTERNAL HELIUM LEAKAGE FOR THE DISCONNECT INTERFACE MATING SEAL. THE INTERFACE SEAL AND BOTH SWIVEL SEALS ARE OF THE RACO TYPE WHICH IMPROVES ITS SEALING CAPABILITY WITH AN INCREASE IN UPSTREAM PRESSURE. MATED LEAKAGE WAS MEASURED DURING QUALIFICATION TESTING AND IS A PART OF THE ATP. THE DISCONNECT HAS SUCCESSFULLY MET LEAKAGE REQUIREMENTS. FOLLOWING MATING OF THE GROUND UMBILICAL AT THE LAUNCH SITE, THE MATED LEAKAGE IS ALSO CHECKED.

(B) TEST:

ATP

EXAMINATION OF PRODUCT

PROOF PRESSURE

DEMATED

FLIGHT HALF: 1,900 PSIG

GROUND HALF: 9,000 PSIG

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MATED: 1,900 PSIG

OPERATION TEST

MATE, PRESSURIZE TO 950 PSIG WITH GHE, AND MEASURE EXTERNAL LEAKAGE
(200 SCIM MAX)
CRACK/RESEAT PRESSURE (15 PSID MIN)
DEMATE

EXTERNAL LEAKAGE

DEMATED
FLIGHT HALF
1 SCIM AT 5 PSIG
10 SCIM AT 950 PSIG
GROUND HALF
200 SCIM AT 950 PSIG
MATED: 200 SCIM AT 950 PSIG

CERTIFICATION

SHOCK PER MIL-STD-810

DESIGN
BENCH HANDLING
AT COMPLETION PERFORM OPERATION AND EXTERNAL LEAKAGE TESTS

FLOW CAPACITY (MATED)

675 PSIG INLET, 1.27 LB/SEC GN2, 18 TO 23 PSID

VIBRATION

RANDOM (TWO AXES)
9 MIN. IN EACH AXIS, MATED
52 MIN. IN EACH AXIS, FLIGHT HALF
9 MIN. IN EACH AXIS, GROUND HALF
TRANSIENT (TWO AXES)
5 TO 35 HERTZ Ñ 0.25 G IN EACH AXIS
BEFORE/AFTER PERFORM OPERATION AND EXTERNAL LEAKAGE TESTS

THERMAL CYCLE (5 CYCLES EACH)

FLIGHT HALF: +70°F TO -250°F; PRESSURIZE TO 600 PSIG; -250°F TO +70°F TO
+190°F; VENT; +190°F TO +70°F
GROUND HALF: PRESSURIZE TO 2,000 PSIG; +70°F TO -250°F; PRESSURIZE TO 4,500
PSIG; VENT; -250°F TO +70°F
AT CONCLUSION, PERFORM OPERATION & EXTERNAL LEAKAGE TESTS

LIFE TEST

LOW TEMPERATURE (-250°F): 100 CYCLES
MATE, PRESSURIZE TO 950 PSIG, DEMATE, VENT
AMBIENT: 1,900 CYCLES
MATE, PRESSURIZE TO 950 PSIG, VENT, DEMATE
AFTER EACH 500 CYCLES, PERFORM EXTERNAL LEAKAGE TEST AND HIGH
TEMPERATURE EXTERNAL LEAKAGE TEST

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HIGH TEMPERATURE EXTERNAL LEAKAGE TEST

MATED: PRESSURIZE TO 950 PSIG WITH +165°F GHE; 200 SCIMS MAX
FLIGHT HALF: HEAT TO +190°F, PRESSURIZE TO 950 PSIG; 20 SCIMS MAX

BURST

3,800 PSIG MATED
3,800 PSIG FLIGHT HALF
18,000 PSIG GROUND HALF

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

INCOMING COMPONENTS AND MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIALS AND PROCESSES CERTIFICATION.

CONTAMINATION CONTROL

ALL PARTS AND ASSEMBLIES ARE MAINTAINED TO CLEANLINESS LEVEL 100A AS PER REQUIREMENTS. POST TEST DISCONNECT INLET AND OUTLET PROTECTION, TO MAINTAIN INTERNAL CLEANLINESS, IS VERIFIED BY INSPECTION. SEALS AND SEALING SURFACES PROTECTION ARE ALSO VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. TORQUES APPLIED TO COUPLINGS ARE VERIFIED PER DRAWING SPECIFICATIONS. PRIOR TO INSTALLATION, SEALS ARE VISUALLY EXAMINED FOR DAMAGE AND CLEANLINESS USING 10X MAGNIFICATION. SEALING SURFACE OF THE POPPET IS INSPECTED. THE CLEAN ROOM LOG AND TOOL CALIBRATION RECORDS ARE VERIFIED BY INSPECTION. INSPECTION POINTS ARE ESTABLISHED TO VERIFY ASSEMBLY PROCESSES.

CRITICAL PROCESSES

APPLICATION OF DRY FILM LUBRICANT TO PARTS IS VERIFIED BY INSPECTION. HEAT TREATMENT AND PART PASSIVATION ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

FLUORESCENT PENETRANT INSPECTION OF THE BODY HOUSING IS VERIFIED.

TESTING

ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING FOR SHIPMENT IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

SEVERAL CASES OF EXTERNAL LEAKAGE HAVE OCCURRED DURING QUALIFICATION TESTING (REFERENCE CAR'S A7972, AB0058, A9741). SEALING SURFACES ON TWO UNITS WERE DETERMINED TO NOT BE OF SUFFICIENT QUALITY TO SEAL AT LOW TEMPERATURES. THE DESIGN WAS CHANGED TO REQUIRE RMS 8 FINISH VERSUS RMS 16.

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EXCESSIVE LEAKAGE WAS OBSERVED ON TWO MATED DISCONNECTS DURING ATP (REFERENCE CAR A6772, A6829). INADEQUATE BURNISHING OF THE MATING SURFACES WAS THE CAUSE. THE SUPPLIER CHANGED ITS MANUFACTURING PLANNING TO PROVIDE PROPER BURNISHING ON THE AREAS CONTAINING TIOLUBE COATING.

ONE DISCONNECT FAILED THE EXTERNAL LEAKAGE REQUIREMENT DURING ATP DUE TO CONTAMINATION BEING LODGED AT THE SEAL INTERFACE (REFERENCE CAR AB8396). IT IS BELIEVED THE CONTAMINATION WAS GENERATED DURING THE ASSEMBLY PROCESS. ASSEMBLY PERSONNEL WERE INSTRUCTED AND CAUTIONED.

AN AUDIBLE LEAK WAS OBSERVED ON A DISCONNECT DURING ATP (REFERENCE CAR AB5095). THE CAUSE OF THE LEAK WAS A SEAL THAT HAD BEEN INSTALLED BACKWARDS. THE SEAL INSTALLATION WAS CORRECTED AND THE UNIT SUCCESSFULLY PASSED ATP. THE SUPPLIER CORRECTED THE MANUFACTURING ROUTE SHEET AND INSPECTION RECORDS WILL VERIFY PROPER INSTALLATION.

DURING ATP AT THE SUPPLIER, EXCESSIVE LEAKAGE WAS DETECTED (REFERENCE CAR AC8113). INVESTIGATION REVEALED A SCRATCH ACROSS THE FACE OF THE INTERFACE SEAL. A SMALL PARTICLE OF CONTAMINATION PROBABLY BECAME LODGED DURING ASSEMBLY. THE SEAL WAS REPLACED AND THE UNIT SUCCESSFULLY PASSED ATP.

CURRENT DATA ON TEST FAILURE, FLIGHT FAILURE, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE.

(E) OPERATIONAL USE:

FLIGHT:

NO CREW ACTION CAN BE TAKEN

GROUND:

GROUND OPERATIONS SAFING PROCEDURES CONTAIN SAFING SEQUENCE OF EVENTS FOR MAJOR LEAKS IN THE HYDROGEN/OXYGEN SYSTEM.

- APPROVALS -

S&R ENGINEERING	: W.P. MUSTY	:/S/ W. P MUSTY
S&R ENGINEERING ITM	: P. A. STENGER-NGUYEN	:/S/ P. A. STENGER-NGUYEN
DESIGN ENGINEERING	: MIKE FISCHER	:/S/ MIKE FISCHER
MPS SUBSYSTEM MGR.	: TIM REITH	:/S/ TIM REITH
MOD	: BILL LANE	:/S/ BILL LANE
USA SAM	: MIKE SNYDER	:/S/ MIKE SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	:/S/ SUZANNE LITTLE
NASA SR&QA	: ERICH BASS	:/S/ ERICH BASS